Ministerie van Verkeer en Waterstaat

Rijkswaterstaat

Flooding Risk in the Netherlands

Results, review and follow-up

Overview of flood defence in the Netherlands

July 11, 2006

Alex Roos, Project Manager Risk of Flooding

Outline

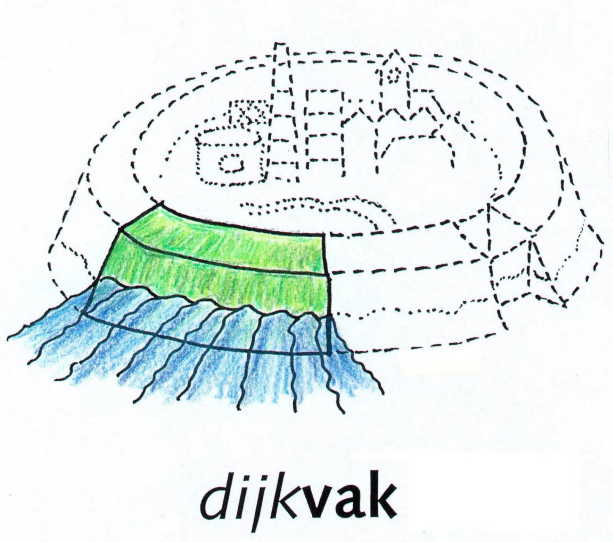
July 11, 2006

- FLORIS project
  - Overview
  - Results
  - Review
- Future developments
  - Continuation of FLORIS project
  - Debate “Water Safety in the 21st Century”

Flood Risks in the Netherlands

July 11 , 2006

- Advice of “TAW” 1999, 4 dike ring area’s
- Comparable with IPET Risk & Reliability Analysis
- Start FLORIS project 2001
- Goal: determine probabilities and consequences of flooding in the Netherlands (53 dike ring area’s)
- Cost: 12 MEuro
- Finished 2005
- ±10 RWS personnel
- 5 combinations of contractors



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Results

- Method applied in practice
- 16 dike ring areas
- 3 area's detailed
- 13 area's course

Bijlage D - Resultaten berekeningen dijkvakken DR36

Faalkans per faalmechanisme	parameter										
vakken	Overloop/overslag		Opbarsten en piping		Beschadiging bekleding en erosie dijklichaam		Afschuiven		Gecombineerde faalkans over de faalmechanismen		
	--		--		--		--		kans	beta	1/kans
6001 - Boxmeer 1	1.30E-04	3.65	1.42E-08	5.55	3.60E-08	5.39	-	-	1.30E-04	3.65	7692
6002 - Boxmeer 2	4.36E-05	3.92	1.42E-06	4.68	1.15E-07	5.17	-	-	4.50E-05	3.92	22222
6003 - Boxmeer 3	1.93E-05	4.12	5.29E-12	6.80	3.10E-06	4.52	-	-	2.23E-05	4.08	44843
6004 - Boxmeer 4	9.74E-06	4.27	3.60E-11	6.52	5.07E-09	5.73	-	-	9.74E-06	4.27	102669
6005 - Beugen 1	4.57E-05	3.91	9.65E-05	3.73	5.70E-09	5.71	-	-	1.30E-04	3.65	7692
6006 - Beugen 2	1.79E-05	4.13	1.72E-04	3.58	1.90E-10	6.26	-	-	1.85E-04	3.56	5405
6007 - Oeffelt 1	2.32E-06	4.58	5.81E-10	6.09	7.57E-09	5.66	-	-	2.32E-06	4.58	431034
6008 - Oeffelt 2	3.10E-06	4.52	5.35E-11	6.46	1.39E-14	7.61	-	-	3.10E-06	4.52	322581
6009 - Oeffelt 3	6.41E-06	4.36	2.24E-08	5.47	2.37E-13	7.23	-	-	6.41E-06	4.36	156006
6010 - Oeffelt 4	1.22E-04	3.67	1.35E-07	5.14	3.42E-08	5.40	-	-	1.22E-04	3.67	8197
6011 - Oeffelt 5	9.24E-05	3.74	-	-	2.97E-06	4.53	-	-	9.50E-05	3.73	10526
6012 - St. Agatha 1	3.72E-05	3.96	5.39E-08	5.31	6.58E-13	7.09	-	-	3.72E-05	3.96	26882
6013 - St. Agatha 2	7.00E-05	3.81	4.47E-07	4.91	4.75E-12	6.81	-	-	7.01E-05	3.81	14265
6014 - St. Agatha 3	8.15E-05	3.77	7.27E-10	6.05	4.02E-09	5.77	-	-	8.15E-05	3.77	12270
6015 - St. Agatha 4	7.49E-05	3.79	-	-	2.73E-08	5.44	-	-	7.49E-05	3.79	13351
6016 - St. Agatha 5	3.37E-05	3.99	3.57E-09	5.79	5.78E-09	5.71	-	-	3.37E-05	3.99	29674
6017 - Cuijk 1	5.59E-05	3.86	3.01E-10	6.19	6.55E-06	4.36	-	-	6.14E-05	3.84	16287
6018 - Katwijk 1	3.54E-04	3.39	4.19E-11	6.49	1.94E-07	5.08	-	-	3.54E-04	3.39	2825
6019 - Katwijk 2	1.56E-04	3.61	3.65E-07	4.95	1.95E-07	5.07	-	-	1.56E-04	3.61	6410
6020 - Katwijk 3	1.38E-04	3.64	1.54E-08	5.54	3.92E-07	4.94	-	-	1.39E-04	3.64	7194
6021 - Katwijk 4	7.75E-05	3.78	1.12E-06	4.73	4.17E-08	5.36	-	-	7.81E-05	3.78	12804
6022 - Katwijk 5	5.86E-05	3.85	1.57E-10	6.29	1.18E-07	5.17	-	-	5.87E-05	3.85	17036
6023 - Beers 1	9.79E-05	3.72	1.38E-12	6.99	3.93E-08	5.37	-	-	9.79E-05	3.72	10215
6024 - Beers 2	9.70E-05	3.73	2.00E-12	6.94	3.32E-08	5.40	-	-	9.71E-05	3.73	10299
6025 - Beers 3	3.08E-04	3.42	6.79E-13	7.09	1.96E-08	5.50	-	-	3.08E-04	3.42	3247
6026 - Escharen 1	4.93E-05	3.89	2.28E-11	6.59	2.34E-07	5.04	-	-	4.95E-05	3.89	20202
6027 - Escharen 2	8.03E-05	3.77	-	-	9.92E-07	4.76	-	-	8.10E-05	3.77	12346
6028 - Escharen 3	8.03E-05	3.77	1.31E-05	4.20	2.43E-08	5.46	-	-	9.13E-05	3.74	10953
7001 - Dp 274.6 - 285 haven en	4.47E-05	3.92	3.13E-04	3.42	1.17E-10	6.34	-	-	3.39E-04	3.40	2950
7002 - Dp 285 - 290 Mars en	4.82E-05	3.90	7.59E-05	3.79	1.84E-08	5.51	-	-	1.14E-04	3.69	8772
7003 - Dp 290 - 296 Mars en	3.17E-05	4.00	9.39E-04	3.11	8.50E-08	5.23	-	-	9.45E-04	3.11	1058

Results

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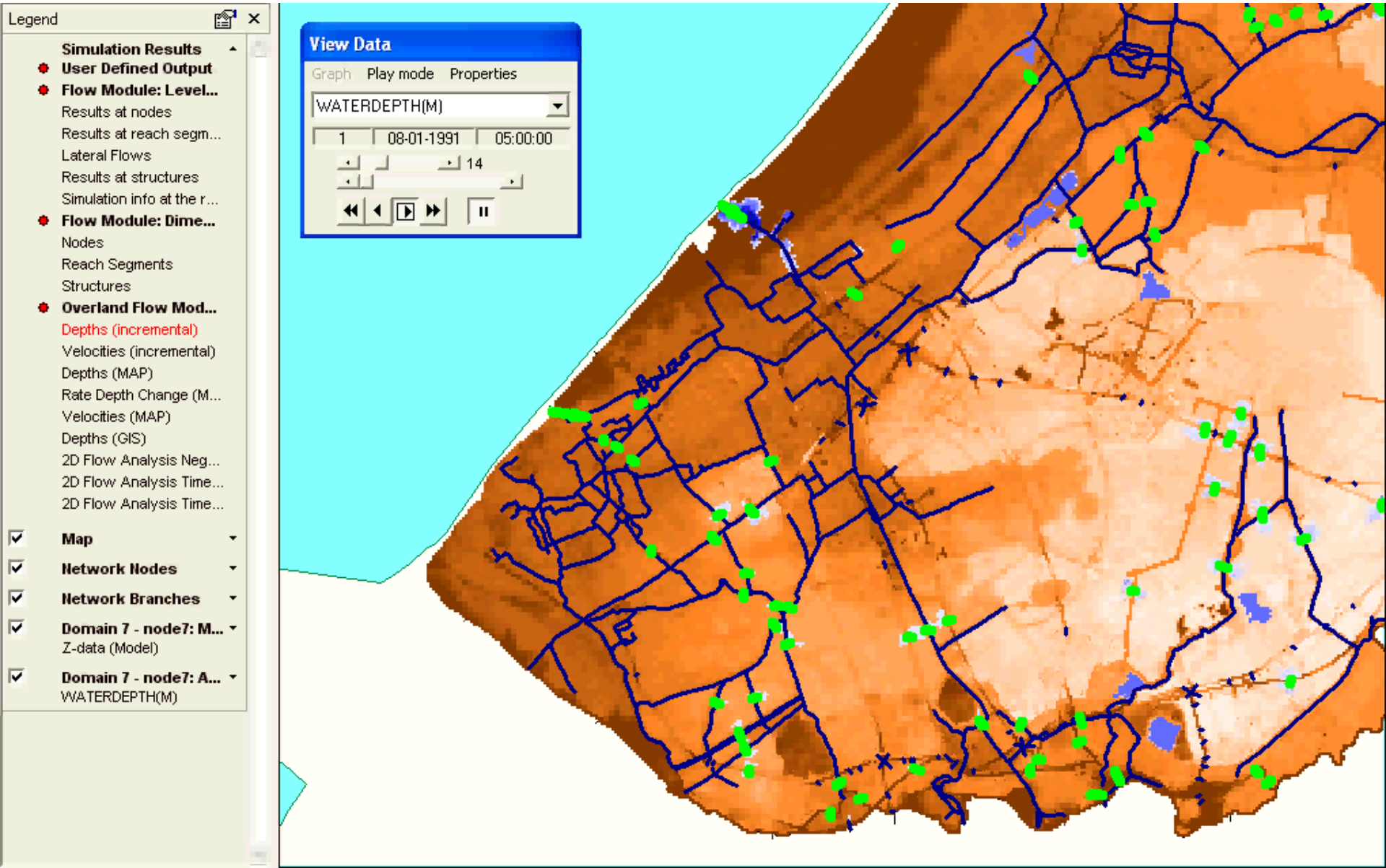
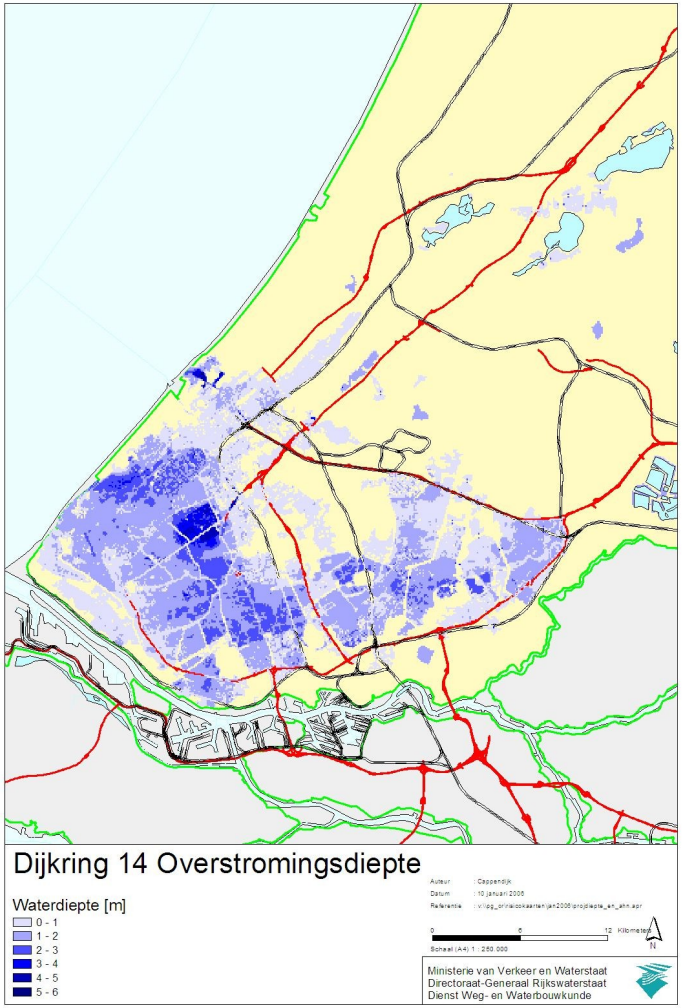
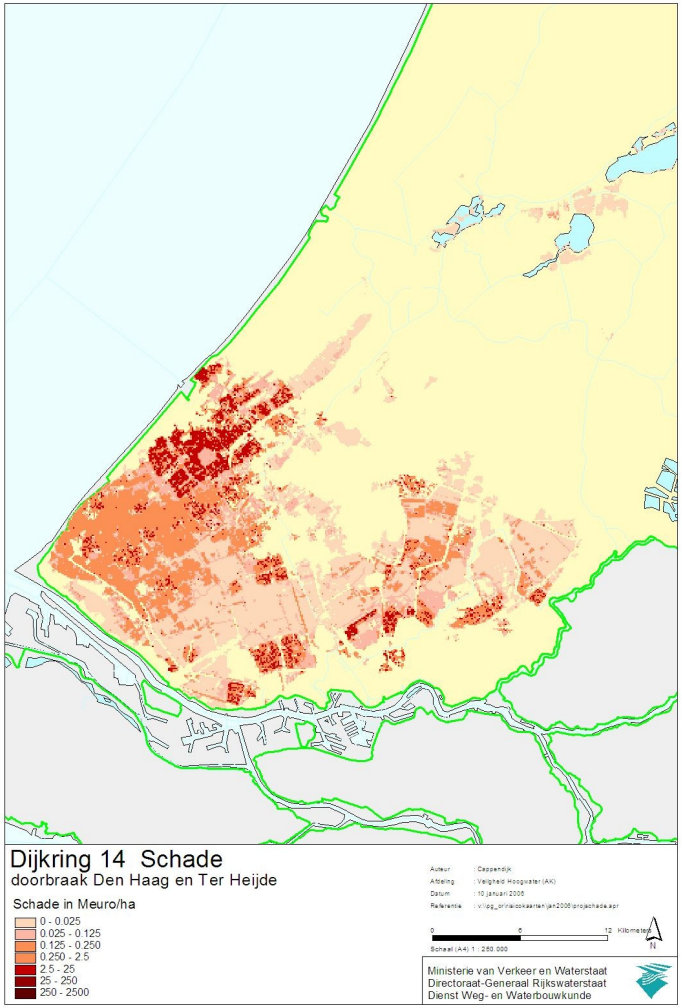


Results

July 11 , 2006





Results

Dike ring	Probability (1/yr)	economic damage* (billion €)	Loss of life#
Noordoost-polder	1/900	1.9 (0.17 – 4.2)	5-1400
South Holland	1/2500	5.8 (0.28 – 37)	30-6100
Land van Heusden	>1/100	2.8 (0.06 – 7.5)	5-800

*: Average economic damage for different scenarios

#: bandwidth gives numbers for different scenarios and different situations with respect to evacuation

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Results

- Insight in probabilities and consequences of flooding
- Closure of structures and piping are often (possible) weak spots
- Insight in flooding scenario's and consequences is very useful information for emergency management

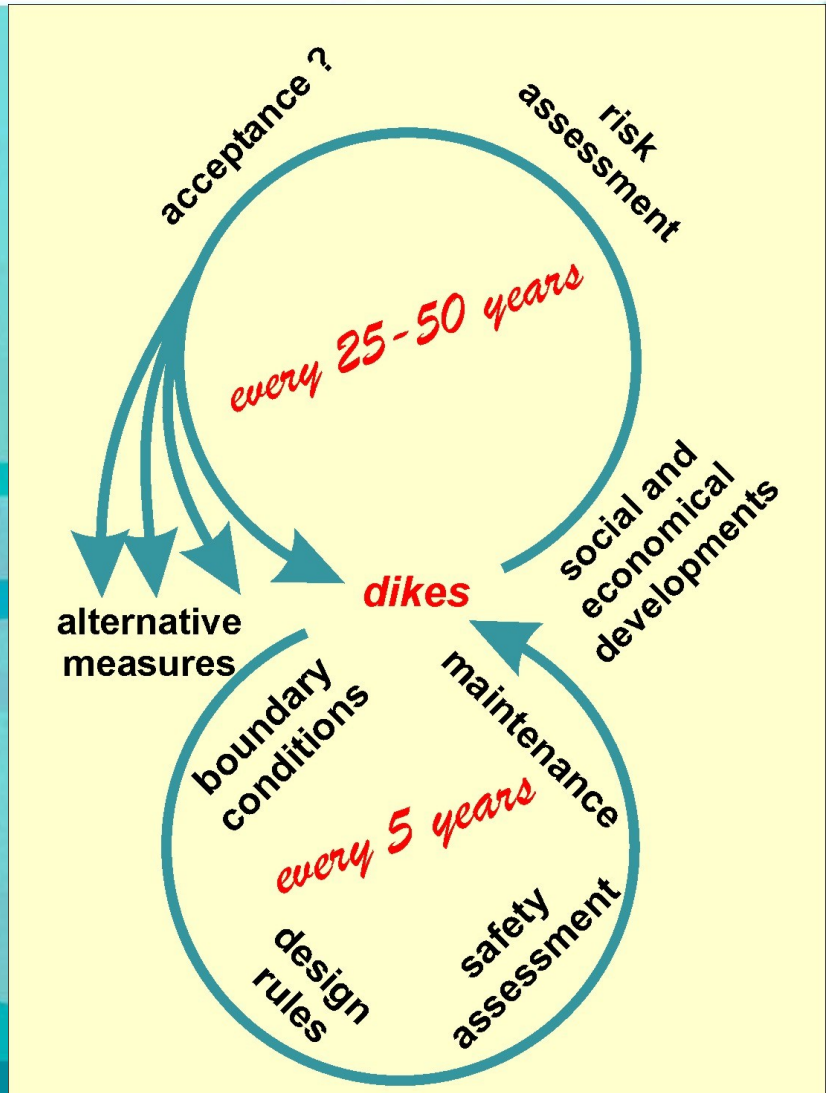
Review

- Method development was needed during production => delay in production
- Data not always available (soil, structures)
- Uncertainties in data => large probabilities
- Knowledge level RWS and contractors
- Tight time schedule

- Knowledge has been distributed through project
- Broad support for method
- Data is very useful for policy development (what if scenario's, risk awareness, risk communication, emergency management)

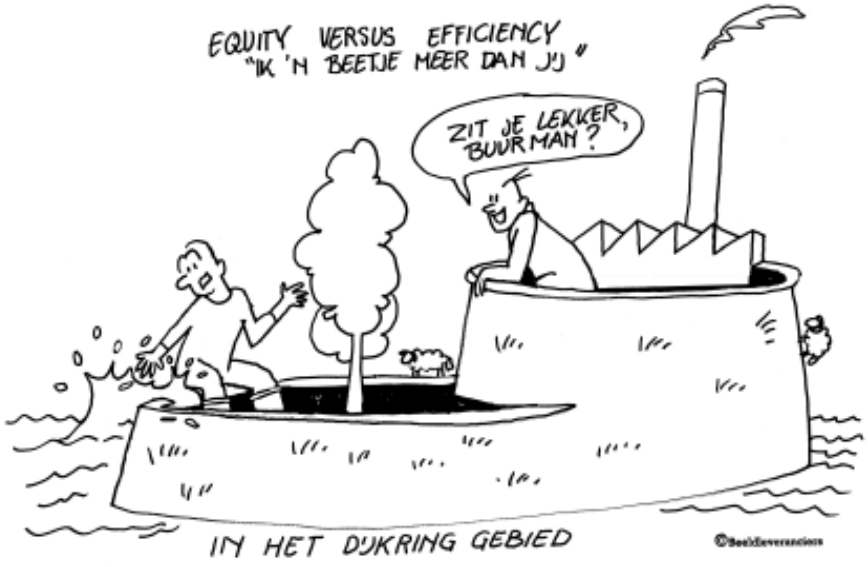
Future developments

- Standards set in 1960's, growth since then:
  - Population from 10 to 16 million
  - Economy: NNP from 17 to 350 billion €
- Two rounds of Safety Assessment (2001 & 2006)
- FLORIS is first step in upper circle
- FLORIS is expanded to 53 area's in Netherlands
- Are policy changes needed?



Future developmer

- Debate “Flood Safety in the 21th century”
- 2006: During March – July several meetings with experts & administrators
- 2006 November : letter to parliament containing Strategic Basic Principles
- 2007-2009: Towards a new policy??



Future developments

Elements of new policy:

- Safety standard in terms of probability of flooding
- Robust standards
- More measures along “chain of safety”
  - Compartments
  - Evacuation
  - Spatial planning
  - …
- New standard based on cost-benefit analysis

.. If we see a hole, we can always use this....